

**Case 3536*****Stegosaurus* Marsh, 1877 (Dinosauria, Ornithischia): proposed replacement of the type species with *Stegosaurus stenops* Marsh, 1887**

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**Abstract.** The purpose of this application, under Article 81.1 of the Code, is to preserve stability in the taxonomy of stegosaurian dinosaurs by replacing *Stegosaurus armatus* Marsh, 1877, the unidentifiable type species of the ornithischian dinosaur genus *Stegosaurus* Marsh, 1877, with the very well represented nominal species *Stegosaurus stenops* Marsh, 1887, also from the Upper Jurassic Morrison Formation, U.S.A. This genus is the basis for Stegosauria Marsh, 1877, STEGOSAUROIDEA Marsh, 1880, STEGOSAURIDAE Marsh, 1880 and STEGOSAURINAE Marsh, 1880. Maidment et al. (2008) listed seven putative autapomorphic characters for *Stegosaurus* and five for the species *Stegosaurus armatus* in its current usage. However, the holotype of *S. armatus*, which consists of an articulated series of 18 incomplete vertebrae from the proximal half of the tail and a very large but incomplete dermal plate, shows none of these diagnostic characters and so *S. armatus* must be considered a nomen dubium. However, the holotype of *S. stenops* Marsh, 1887 shares all 12 autapomorphies with *S. armatus* in its current usage, being based on an almost complete skeleton (USNM 4934), most of it still in the rock preserving almost natural articulation, which would make *S. stenops* by far the best available species to replace *S. armatus* as type species of *Stegosaurus* Marsh, 1877.

**Keywords.** Nomenclature; taxonomy; Dinosauria; Ornithischia; Stegosauria; STEGOSAURIDAE; STEGOSAURINAE; *Stegosaurus*; *S. armatus*; *S. stenops*; western U.S.A.; Upper Jurassic.

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1. Marsh (1877, p. 513) established *Stegosaurus armatus* (and the order Stegosauria) based on unfigured material (YPM 1850) from Morrison, Wyoming from what is now known as the Morrison Formation, the source of all stegosaurs collected from the U.S.A. Marsh (1880) also erected the STEGOSAURIDAE. Subsequent workers recognised *Stegosaurus armatus* without reference to the holotype that was redescribed by Carpenter & Galton (2001; see also Galton 2010, fig. 1). YPM 1850 includes several incomplete vertebrae: 2 dorsals, caudal 1 or 2, an anterior caudal vertebra, several blocks containing 16 incomplete articulated vertebrae from the proximal half of the tail, and a very large but incomplete dermal plate.

2. Cope (1878) described, but did not illustrate, material from Garden Park near Cañon City, Colorado, as *Hypsirhophus discursus*. The holotype (AMNH 5731) is a dorsal vertebra and an incomplete anterior caudal neural arch. It was redescribed by Carpenter (1998a), who tentatively considered it to be a valid taxon, as did Carpenter



et al. (2001), based on characters of the dorsal vertebra. It has also been regarded as a junior synonym of *Stegosaurus armatus* (Galton, 1990; Galton & Upchurch, 2004; Maidment et al., 2008; Maidment, 2010) or as a valid species (Galton 2010).

3. Marsh (1879, p. 504) briefly described *Stegosaurus ungulatus* based on two partial skeletons YPM 1853 (which may represent more than one individual, see Carpenter & Galton, 2001) and YPM 1858 from YPM Quarries 12 and 11, respectively, at Como Bluff near Como station, Wyoming. Bones of the syntypes were figured by Marsh (1880, 1881a, 1891, 1896), Lull (1910), Gilmore (1914), Ostrom & McIntosh (1966, 1999), Carpenter & Galton (2001) and Galton (2001, 2010). *S. ungulatus* is currently regarded as a junior synonym of *S. armatus* (Galton, 1990; Galton & Upchurch, 2004; Maidment et al., 2008) or as a valid species (Galton & Carpenter, 2001; Galton 2001, 2010, figs. 2b, 3a–e, k–o, r).

4. Marsh (1881b, p. 421) established *Diracodon laticeps* based on the characters of teeth in a pair of maxillae from YPM Quarry 13, Como Bluff. Gilmore (1914) considered a distal tail with spikes (USNM 4288) and three carpal bones in manus referred to *Diracodon laticeps* by Marsh (1887, p. 416, pl. 9), and probably also the holotype maxillae, to represent juvenile individuals of *Stegosaurus stenops* Marsh, 1887 (Gilmore, 1914, pp. 104, 108–109). The two incomplete holotype tooth-bearing bones, YPM 1885, were first illustrated as dentaries by Carpenter & Galton (2001). *Diracodon laticeps* Marsh, 1881b is regarded as a nomen dubium (Carpenter & Galton, 2001) or, incorrectly, as a valid taxon (Bakker, 1986, pp. 188, 227) or a junior synonym of either *Stegosaurus stenops* Marsh, 1887 (Galton, 1990, 2010; Galton & Upchurch, 2004) or *S. armatus* Marsh, 1877 (Maidment et al., 2008).

5. In 1887 Marsh figured a complete skull (USNM 4934) from Garden Park as *Stegosaurus stenops*. The rest of the skeleton, which is still in more or less natural articulation as found with 17 plates in position (see Gilmore, 1914; Czerkas, 1987) is complete except for a few distal caudal vertebrae and the anterior pair of tail spikes. The bones were described by Gilmore (1914) and illustrated by Marsh (1891, 1896) and Ostrom & McIntosh (1966, 1999). The skull was also described by Huene (1914) and reconstructed in several views by Galton (1990), Sereno & Dong (1992) and Galton & Upchurch (2004). Reconstructions of the skeleton, with the last part of the tail and the anterior pair of tail spikes based on USNM 4714 from YPM Quarry 13, Como Bluff (Gilmore 1914) were given by Czerkas (1987) and by Paul (1992), Galton (1997, 2010) and Carpenter (2010) who also used data from a second articulated, almost complete referred skeleton from Garden Park (DMNH 2818, see Carpenter, 1998b, fig. 2 as found in quarry, 2007, fig. 2 for other side; found stratigraphically within 10 m of the holotype). *S. stenops* is regarded either as a valid species (Galton, 1990, 2010; Galton & Upchurch, 2004; Carpenter et al., 2001; Carpenter, 2010) or as a junior synonym of *S. armatus* (Maidment et al., 2008; Maidment, 2010).

6. *Stegosaurus duplex* Marsh, 1887 (p. 416) is based on a partial skeleton lacking dermal armor (YPM 1858) from YPM Quarry 12 at Como Bluff, which was described and/or illustrated by Marsh (1881a, 1891, 1896), Lull (1910), Ostrom & McIntosh (1966, 1999) and Carpenter & Galton (2001). *S. duplex* has been regarded as a junior objective synonym of *S. ungulatus* Marsh, 1879 (Lull, 1910; Gilmore, 1914; Carpenter & Galton, 2001; Galton, 2001, 2010; Maidment et al., 2008, p. 382), which in turn is either a valid species or a junior synonym of *S. armatus* (see section 3).



7. Marsh (1887) illustrated a tail spike, USNM 4937 from YPM Quarry 13 at Como Bluff, as *Stegosaurus sulcatus*. Gilmore (1914) figured this tail spike in articulation with its antimere that lacks sulci. Bakker (1988) showed that the curvature of the very wide spike bases was too shallow to fit over the distal part of the tail. This species is regarded as valid (Galton, 2010, figs. 3g, q), as a junior synonym of *S. armatus* (Galton, 1990; Galton & Upchurch, 2004), or as a nomen dubium (Maidment et al., 2008).

8. Gilmore (1914) described and diagnosed the species of *Stegosaurus* based on the USNM holotypes of *S. stenops* and *S. sulcatus*, and reproduced line drawings of *S. unguatus* from Marsh (1896). He erected *S. longispinus* for a partial skeleton, UW D54 (now UW 20503) from Alcova, Natrona County, Wyoming. This species is considered to be a nomen dubium (Maidment et al., 2008) or valid (Galton, 1990, 2010; Carpenter et al., 2001; Galton & Upchurch, 2004); it is diagnosed by very distinctive distal caudal vertebrae and two pairs of very elongate tail spikes with sub-equal bases (Galton, 2010, figs. 3h–j, u, v).

9. Ostrom & McIntosh (1966, reprinted 1999) provided copies of the unpublished lithographic plates of *Stegosaurus* prepared under the supervision of O.C. Marsh in the 1880s. They labelled specimens as *S. armatus* (referred braincase USNM 4936 from Garden Park; braincase and associated postcrania described by Galton (2001) as *S. stenops*), *S. unguatus* (with *S. duplex* as a junior synonym), *S. stenops* and *S. sulcatus*.

10. Galton (1990; also Galton & Upchurch, 2004) noted that the holotype of *Stegosaurus armatus* needed further preparation but considered that *S. unguatus* was probably a junior synonym, along with *Hypsirhopus discursus*, *Stegosaurus sulcatus* and *S. duplex*. *S. stenops* and *S. longispinus* were regarded as separate valid species.

11. Carpenter et al. (2001) described *Hesperosaurus mjosi* based on a partial skeleton (HMNH 001, cast DMNH 29431) from low in the Morrison Formation in Johnson County, Wyoming. The holotype consists of a nearly complete, disarticulated skull, a complete vertebral column, a partial left scapula and coracoid, ilia, ischia, pubes, 11 dermal plates and four tail spikes. Carpenter et al. (2001) recognised *Stegosaurus armatus*, *S. unguatus*, *S. stenops*, *S. longispinus* and *Hypsirophus discursus* as valid species. They also pointed out that the three genera of Morrison stegosaurs have a restricted distribution within the Dinosaur Zones of Turner & Peterson (1999), with *Hesperosaurus* limited to Zone 1, *Stegosaurus* to Zones 2 and 3, and *Hypsirophus* to Zone 4.

12. Based on a cladistic analysis of the species of Stegosauria they considered to be valid, Maidment et al. (2008) gave seven autapomorphies for the genus *Stegosaurus* sensu Maidment et al. (2008) and five for the species *armatus*, with *Hypsirophus discursus*, *Stegosaurus unguatus* (with *S. duplex* as a subjective junior synonym), *Diracodon laticeps*, and *Stegosaurus stenops* as junior synonyms of *S. armatus*, and *S. sulcatus* and *S. longispinus* as nomina dubia. *Hesperosaurus mjosi* and *Wuerhosaurus homheni* Dong, 1973 (Lower Cretaceous, China, see Dong, 1990) were referred to *Stegosaurus* as *S. mjosi* (Carpenter et al., 2001) and *S. homheni* (Dong, 1973) and also by Maidment (2010).

13. Mossbrucker et al. (2009) noted that further preparation of the blocks of YPM 1850 showed that two fit together (indicated by \*, Galton 2010, fig. 1b) to give taller than predicted neural spines for mid-caudal centra, a possibly diagnostic character for *Stegosaurus armatus* as defined by the holotype.



14. Carpenter (2010) provided a revised diagnosis of *Hesperosaurus mjosi* (with contrasting character states for *Stegosaurus stenops*) that included characters from two referred skeletons from low in the Morrison Formation near Howe Ranch, Wyoming (see Siber & M $\ddot{o}$ ckli, 2009). He considered that there are too many differences between the skeletons of *H. mjosi* and *Stegosaurus stenops* to support referral to the same genus (see skeletal reconstructions in Carpenter, 2010, figs. 7a, b).

15. Maidment (2010) presented a historical survey of the stegosaurian species described from the Morrison formation and repeated the systematic conclusions of Maidment et al. (2008), i.e. recognising *Stegosaurus armatus* (with *Hypsirophus discursus*, *Stegosaurus unguulatus*, *Diracodon laticeps* and *Stegosaurus stenops* as junior synonyms) and *S. mjosi* as valid taxa [also *S. homheni* (Dong, 1973)].

16. Galton (2010) noted that the holotype of *Stegosaurus armatus* displayed none of the five putative autapomorphic characters listed by Maidment et al. (2008) for the species *armatus* in its current usage and only one of the seven autapomorphic characters for the genus *Stegosaurus*, i.e. the transverse process on the anterior caudal vertebrae (except C1 and C2) projects ventrally rather than laterally. But the holotype of *Hesperosaurus mjosi* also has this feature, hence YPM 1850 actually displays no autapomorphic characters of *S. armatus* in its current usage and so *S. armatus* as defined by the holotype should therefore be considered a nomen dubium. *Hypsirophus discursus* Cope, 1878 and *Diracodon affinis* Marsh, 1881a, each with one of the autapomorphic characters of the species *armatus* in its current usage, are available as possible replacement type species for *Stegosaurus* Marsh, 1877. As noted in previous sections, most of the other species of *Stegosaurus* available as a replacement type species are based on incomplete, disarticulated partial skeletons with no skull or field records, i.e. *S. unguulatus* (has braincase but at least two individuals involved), *S. duplex*, *S. sulcatus* and *S. longispinus* (details in Galton, 2010). In marked contrast, the holotype skeleton (USNM 4934) of *S. stenops* is almost complete, with a skull. It is mostly preserved in the rock as found, and there is another comparable complete articulated skeleton from the type locality. *Stegosaurus stenops* Marsh, 1887 displays all 12 autapomorphies determined for the currently accepted concept of *S. armatus* Marsh, 1877 by Maidment et al. (2008), and is) the only species showing the following two: alternating rows of dermal plates down the midline for *Stegosaurus* (also in DMNH 2818), and nuchal dermal ossicles for *S. armatus* (also in DMNH 2818). Consequently, Galton (2010) indicated the need to petition the Commission to designate *Stegosaurus stenops* Marsh, 1887 as the new type species of *Stegosaurus* Marsh, 1877 to replace *S. armatus* Marsh, 1877. This action would preserve stability by conserving *Stegosaurus* Marsh, 1877, Stegosauria Marsh, 1877, STEGOSAURIDAE Marsh, 1880, STEGOSAUROIDEA Marsh, 1880 and STEGOSAURINAE Marsh, 1880.

17. Should the more elongate mid-caudal neural spines of YPM 1850 prove to be a diagnostic character, as suggested by Mossbrucker et al. (2009), then this would be diagnostic for the species *armatus* as defined by the holotype and YPM 1850 would still lack any of the seven autapomorphies of the genus *Stegosaurus* in its current usage (Maidment et al., 2008).

18. The possibility of designating the holotype of *Stegosaurus stenops*, USNM 4934, as a neotype for *S. armatus* Marsh, 1879 in place of the latter's extant holotype YPM 1850, thereby making the two names objective synonyms, has been considered.



However, it was rejected on the basis that the synonymy of the two species cannot be proven and, because of the possible presence of a diagnostic character in the holotype that could differentiate the species *armatus* from other species in the group, this could possibly necessitate the erection of a new species for YPM 1850. The interests of stability at the generic level are not served by having *armatus* as the type species of *Stegosaurus*, because the incomplete and fragmentary holotype of this species lacks the characters of the widely used concept of that genus. In the absence of a Commission's ruling, a new genus could be erected based on *S. stenops*, thereby restricting *Stegosaurus* to *S. armatus*, and giving a new name to the generally accepted concept of the genus *Stegosaurus*. Consequently, conserving the name of the universally known genus *Stegosaurus* in its current usage is considered urgent and important.

19. The International Commission on Zoological Nomenclature is accordingly asked:

- (1) to use its plenary power to set aside all previous fixations of type species for the nominal genus *Stegosaurus* Marsh, 1877 and to designate *Stegosaurus stenops* Marsh, 1887 as the type species;
- (2) to place on the Official List of Generic Names in Zoology the name *Stegosaurus* Marsh, 1877 (gender: masculine), type species *Stegosaurus stenops* Marsh, 1887, as ruled in (1) above;
- (3) to place on the Official List of Specific Names in Zoology the name *stenops* Marsh, 1887, as published in the binomen *Stegosaurus stenops* (specific name of the type species of *Stegosaurus* Marsh, 1877, as ruled in (1) above).

**Institutional abbreviations:** AMNH, American Museum of Natural History, New York, U.S.A.; DMNH, Denver Museum of Nature and Science (formerly Denver Museum of Natural History), Colorado, U.S.A.; HMNH, Hayashibara Museum of Natural History, Okayama, Japan; USNM, National Museum of Natural History (formerly United States National Museum), Washington, D.C., U.S.A.; UW, Department of Geology and Geophysics, University of Wyoming, Laramie, U.S.A; and YPM, Peabody Museum of Natural History, Yale University, New Haven, Connecticut, U.S.A.

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